Experimental Analysis & Optimization of Machining Parameters of Al-7020 Aluminium Alloy in CNC End Milling By Use of Taguchi

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Abstract: Milling is a material removal process in which we can produce a variety of a parts by cutting away unnecessary material. Today Every manufacturing industry is wants to achieve the high quality products in a very short period of time with less input. In milling machine, there are many process parameters like spindle speed, feed rate, depth of cut, coolant, tool geometry etc. which affected on required quality parameters. So, selections of these process parameters are the important for any quality parameters. But, these selected process parameters for required quality parameters are not run at optimal condition. So, process parameters are required to be optimized by using a different method like taguchi method for required quality parameters. Taguchi methodology is widely used for single optimization.The main objective of this research is to select the machining parameters and its cutting conditions to enhance the material removal rate and minimize the machining time and machining cost. In this review paper, Spindle speed, Feed rate and Depth of cut are considered as input parameters for end milling operation of the Al-7020 aluminium alloy using HSS tool material.

Keywords:Depth of Cut, Feed Rate, Machining Time, cutting speed, material removal rate, taguchi method.

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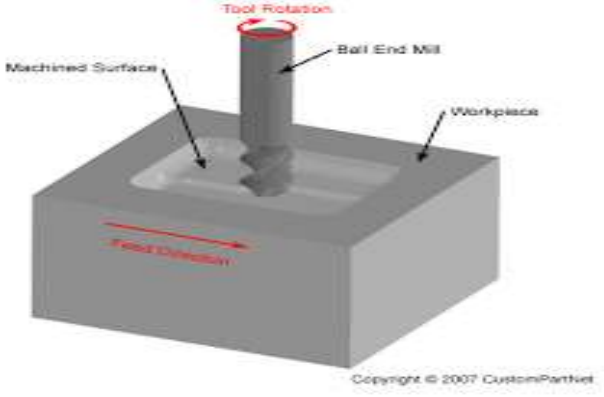
I. INTRODUCTION

In the proposed research work, material removal rate (MRR) and surface roughness of the product prepared by CNC end milling operation are to be studied experimentally and the results are analyzed by using analytical method .In modern time, milling has become popular due to its characteristics such as maximum production rate, minimum operation cost and the quality. The efficiency of milling machine is higher than other traditional machining process such as lathe machine. Out of various machining processes, milling process have a advantage of multi-point cutting tool with high dimensional accuracy. So, it is important to study the various parameters that affect the quality of product. In milling, most commonly machining processes used such as End milling, Face Milling and side milling. End mill is used for finishing the side and face of work piece. End mill cutter have a sharp cutting edges with large flutes to allow chips discharge from cutter. Face milling is the most common milling operation for machining flat surface and can performed using a wide range of different tools.

Today, CNC machining is an indispensable part of machining industry. The accuracy and precision achieved through CNC cannot be achieved by the other conventional manufacturing
Machines. Quality and productivity are two important but differing criteria in every machining operation. Productivity can be interpreted in terms of MRR in the machining operation and quality represent reasonable defer in terms of product characteristics as preferred by the customers. Increase in productivity results to reduction in machining time which may effect in quality loss.



II. WORK PIECE & TOOL SPECIFICATION

Work-piece**:** Al-7020 aluminium alloy
Selection of work-piece:

- *In aerospace and automobile industry, there is demand for materials that are lighter, harder, stronger, tougher, stiffer, more corrosion erosion-resistance properties and superior machinability index.*
- *7000 series is highest strength series of aluminium alloys for aircraft application.*
- *Al-7020 alloy posses all these properties, hence considered under this research as a work-piece material.*

Composition of Al-7020 Aluminium alloy

Si	Fe	Cu	Mn	Cr	Zn	Ti	Zr	Mg	Al
0.30	0.35	0.10	0.24	1.30	0.14	4.70	0.08	0.07	The rest

TOOL**:** High speed tool (HSS)

ALLOYING ELEMENTS PRESENTS IN HSS TOOL

1. Tungsten and molybdenum: improve red hardness, retention of hardness and high temperature strength of the matrix, form special carbides of great hardness.
2. Carbon : forms carbides, increases wear resistance, is responsible for the basic matrix hardness.
3. Vanadium: forms special carbides of supreme hardness, increases high temperature wear resistance, retention of hardness and high temperature strength of the matrix.
4. Chromium: promotes depth hardening, produces readily soluble carbides.
5. Cobalt: improves red hardness and retention of hardness of the matrix.

III. LITERATURE REVIEW

- Amit Joshi et al. (2012) had taken process parameters like cutting speed, depth of cut, feed rate to investigate to reveal their Impact on surface finish using Taguchi Methodology. They had taken L9 orthogonal array to perform experiments. They found the optimal setting for selected process parameters and optimal value of surface finish was obtained at first level of factor A, third level of factor B and second level of factor C. From the ANOVA analysis they were found that feed rate is the most dominating factor for surface finish.
- **B. C. Routara, et al, [1]** were carried out "Roughnessmodeling and optimization in CNC end milling using response surface method: effect of workpiece material variation". They describe use and steps of Full factorial design of experiments to find a specific range and combinations of machining parameters like spindle speed, feed rate and depth of cut to achieve optimal values of response variables like Roughness parameters (Ra, Rq, Rsk, Rku and Rsm) in machining of three different materials like 6061-T4 aluminum, AISI 1040 steel and medium leaded brass UNS C34000. The second-order model was postulated in obtaining the relationship between the surface roughness parameters and the machining variables. The analysis of variance (ANOVA) was used to check the adequacy of the second-order model roughness modeling in milling is specific to the roughness parameter of particular Concern as well as to the work piece-tool material combination employed in the process.
- Prajapati et al. [1]have optimized the machining parameters for SR and MRR in CNC turning.SS 316 (austenite steel) work material of Ø 45 mm and length 35 mm was used in turning in dry environment conditions.In this study, the effect and optimization of machining parameters (cutting speed, feed rate and depth of cut) on SR and MRR is investigated. An L27 Orthogonal array, analysis of variance (ANOVA) and grey relation analysis is used.
- Chandrasekaran et al.[2] studied the machinability of AISI 410 on CNC lathe for SR using taguchi method. The effect and optimization of machining parameters on SR is investigated. L27 Orthogonal array, analysis of variance (ANOVA) are used in this investigation. The experiment was conducted on FANUC CNC lathe. Work material of Ø 32 mm and length 60 mm was used. Benardos et al. [3] studied a neural network modelling approach for the prediction of surface roughness in CNC face milling. Taguchi design of experiments method is used and MATLAB version 5.3.0.10183 (R11) program was used to create, train and test the ANNs..

- Moshat et al, (2010) [4] made an attempt to optimize the CNC end milling process parameters to achieve good surface finish and high removal rate (MRR). The Principal Component Analysis (PCA) based on Taguchi method was used for optimization. It has been found that PCA method makes result more reliable for mult objective problem as it has characteristics to eliminate multi-correlation.
- Joshi et al.[6] Investigated the SR response on CNC milling by Taguchi technique. Analysis of variance (ANOVA) was used in this investigation. The material used for the experiment is (100 x 34 x 20 mm) 5 blocks of aluminium cast heattreatable alloy. The output characteristic, surface finish is analysed by software Minitab 15 and ANOVA is formed, which shows the percentage contribution of each influencing factor on surface roughness.
- Prajapati et al. [1]have optimized the machining parameters for SR and MRR in CNC turning.SS 316 (austenite steel) work material of Ø 45 mm and length 35 mm was used in turning in dry environment conditions.In this study, the effect and optimization of machining parameters (cutting speed, feed rate and depth of cut) on SR and MRR is investigated. An L27 Orthogonal array, analysis of variance (ANOVA) and grey relation analysis is used.

IV. CONCLUSION & FUTURE SCOPES

This paper reviews the effect of various process parameters on the performance parameters during End milling cutting operation.

1. In the CNC milling operation, the machining parameters i.e. cutting speed, feed rate and depth of cut play a major role in deciding the performance parameters such as surface roughness, power consumption, tool wear and material removal rate.
2. In this review paper , cutting parameters are cutting speed, feed, depth of cut and performance parameters are MRR &surface roughness.
3. Find out optimum results by using taguchi for getting higher MRR & high surface finish.
4. Use at least two techniques to optimize the process parameters and compare the results.
5. Optimization of process parameters are done for to get effective result of machining.
6. From the literature review we can conclude that most of the researchers had taken input parameters (speed, feed, depth of cut) and in some cases other parameters such as nose radius, environment etc. and facing output parameters MRR, surface roughness, cutting time. Depth of cut has the major impact on tool wear operation & for surface roughness the most significant parameters are speed, feed and nose radius .

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